Solanum saponaceum. Deposited in the USNM.

Paratypes.—6 ♀♀, 6 ♂♂, same data as holotype. Deposited in the USNM and UCR.

This species is easily distinguished from the only other described Neotropical species, *Mirax brasiliensis* Brues and *M. insularis* Muesebeck, by its dark thorax. In North America it is similar to *M. lithocolletidis* Ashmead but is distinguished by its darker color and more coarsely rugose propodeum. This species is named for my father, Malcolm B. Marsh.

Natural History Notes on Craspedoglossa stejnegeri *and* Thoropa petropolitana *(Amphibia: Salientia, Leptodactylidae)*

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ABSTRACT

Larvae are described for the first time for the burrowing leptodactylid frog, *Craspedoglossa stejnegeri*. The terrestrial larvae resemble those of *Zachaenus parvulus* in several distinctive features. Territoriality is described for the first time for any frog in SE Brazil; male *Thoropa petropolitana* defend calling sites and egg clutches.

During the month of December 1977, we obtained some natural history observations on previously unreported life history parameters for *Craspedoglossa stejnegeri* and *Thoropa petropolitana*. Our observations were made near the city of Teresópolis in the State of Rio de Janeiro, Brazil. Specimens are in the collections of the Museu de Zoologia da Universidade de São Paulo and the National Museum of Natural History, Washington, D. C.

Craspedoglossa stejnegeri

We obtained a series of 29 juvenile and adult *C. stejnegeri* from burrows in hillsides or under logs. During the day, specimens were found in the burrow systems under logs. At night, the frogs were near the mouths of the burrows. In six cases, *Craspedoglossa* and microhylids (a single species, as yet unidentified) shared the same burrows; four of the burrows contained one microhylid and one *C. stejnegeri*, two burrows, two microhylids and one *C. stejnegeri*.

On the morning of 10 December, the second author found a female *C. stejnegeri* with 40 larvae on her back under a 15 cm. diameter log beside a stream. The female sat in a depression below the level of the surrounding soil. Egg capsules were next to the female and one egg had been parasitized. The egg capsules were in a bead-like string. The larvae were very light in color, the yellow yolk being the most striking feature.

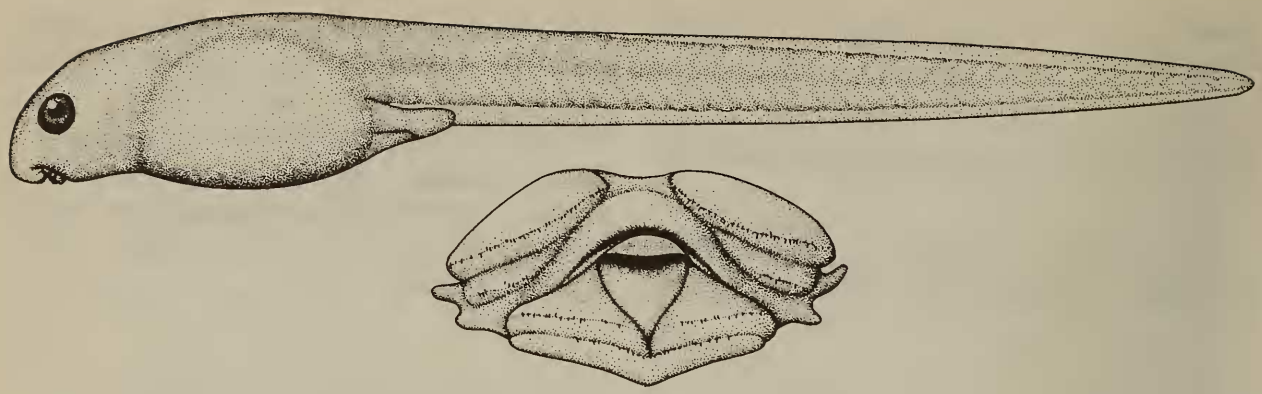

Fig. 1. Lateral view and mouthparts of larva of *Craspedoglossa stejnegeri*.

Thirty-eight of the larvae are stage 31 (Gosner, 1960), two are stage 30. Abundant yolk stores at this stage are obvious (Fig. 1). The oral disk is distinctive in having only two papillae at the lateral margins (Fig. 1). The denticles are not well developed and not clearly visible in all specimens at low magnification. At high magnification, the following tooth row formula is characteristic: 2-2/1$_{\bar{1}}$1. The larvae lack a spiracle, the anus is median and usually bifid. Of 10 larvae measured, the head-body length/total length average is 0.30; the longest larva is 25.2 mm total length.

The larvae of *C. stejnegeri* share the following distinctive features with the larvae of *Zachaenus parvulus* as described by Lutz (1944): No spiracle; general shape of oral disk (Lutz's figures appear almost identical to the mouthparts of Fig. 1); and peculiar bilobed anal tube (see Figure 16 in Lutz, 1944, for a comparable view of the condition in the series of *C. stejnegeri* at hand). The larvae differ in tooth row formulae, the tooth row formula for *Z. parvulus* is 1-1/1 (Lutz, 1944). Lutz describes the upper and lower lips of the disk being connected by 2 or 3 large papillae (as in *C. stejnegeri*), but that the lower lip has shorter, continuous papillae. The lower part of the disk in *C. stejnegeri* is emarginate (Fig. 1). Lutz gives the maximum length of *Z. parvulus* larvae as 19 mm.

The distinctive larvae of *Craspedoglossa stejnegeri* and *Z. parvulus* suggest close relationship, supporting Lynch's (1971) synonymization of these two genera. The distinctive adult morphologies argue for generic recognition, however (Heyer, 1975). The close similarities of larval morphologies indicate that the larvae of *C. stejnegeri* are terrestrial larvae, completing metamorphosis on the nutrients from the large yolk stores.

Lutz (1944) found a *Z. parvulus* egg mass which contained 30 eggs; no adult was in attendance. We found one egg mass of 12 eggs of *Z. parvulus* with an attendant female. It is difficult to imagine a larger clutch size for *Zachaenus parvulus* than what we found, owing to the large eggs and small size of adult females. Lutz may have uncovered a communal nesting site. The eggs of *Zachaenus* are in a clump, not a string as in *Craspedoglossa*.

Thoropa petropolitana

Our observations extend the information provided by Bokermann (1965), who discussed the general ecology of adults and larvae and described the larval morphology and mating call of *Thoropa petropolitana*. Most of our observations were made on a road cut rock wall with a high population density of *T. petropolitana*.

On the night of 4 December, the second author found an amplectant pair (axillary amplexus) in the final process of egg laying. Most of the eggs had been deposited in the characteristic circular mass when discovered. The following sequence was observed

to be the same for deposition of 3 eggs. The male called sporadically (1–3 times), then squeezed the female 2–3 times. The female extruded a single egg. The male then pushed the egg onto the substrate (a vertical bare rock surface, surrounded by rock covered with algal and moss slime) with his right hind foot. The female rotated counterclockwise 5°, and the process was repeated. After the last egg was deposited, the male dismounted and moved about 30 mm from the clutch facing it, calling emphatically. The female straddled the circular clutch and sat on top of the clutch with her nose buried in moss. The total clutch was 16 eggs.

We checked the egg clutch almost daily, and at every observation period but 2, we found the male in attendance. One time when we did not see the male, he was attendant 15 minutes later when we rechecked the clutch. The embryos were at least at the neurula stage on the 4th day and several had died. On the 6th day, tails and movement were evident. On the 9th day, only eight embryos were still alive, the rest were dead. A small hydrophilid water beetle (*Oocyclus* sp.) was in the midst of the egg clutch, where it had apparently eaten its way in. We prodded the beetle. When the beetle moved, the male *Thoropa* reacted in the jerky motions which territorial males perform. The frog advanced on the beetle, bumped it with his chin, put his front foot on it, moved past it, and tried to dislodge it with a kick of his hind foot. The frog made no attempt to eat the beetle. On the 10th day, two larvae had hatched and were still on the jelly. On the 11th day, all but one larva had hatched; all larvae remained on or around the jelly. On the 12th day, all larvae had hatched; two were on the edge of the jelly, the others were gone. The male was absent. On the 13th day, no larvae were around the jelly; the male sat facing the jelly 10 cm away.

We found no males defending more than one clutch of eggs. Male *T. petropolitana* are territorial. Males defend calling sites and egg clutches from other males. One natural agonistic encounter was observed. The resident male gave what we interpret to be a territorial call (a creaking, attenuated note in contrast to the short chirps we interpret as the advertising call), then grabbed the face to face interloping male around the neck and wrestled. The resident released the invader and gave a territorial call followed by 5–6 rapid advertising calls. The invader remained flat on the substrate. The resident turned back towards his calling site, and the invader quickly left with two long hops.

We experimentally introduced males into the territories of other males, who were defending either calling sites or egg clutches. In all cases, the resident male called and postured toward the invading male. In one instance, calling and posturing was adequate to drive off the invader. In all others, physical contact, either wrestling or kicking, occurred. The adpression of the invader to the substrate was a common response. The defended territories are small. We found several instances of males calling 20 cm apart with no interference.

As Wells (1977) recently summarized, "Attachment to a fixed site will be advantageous if this gives the occupant exclusive or priority access to resources in short supply." We suggest that the resource in short supply for *T. petropolitana* is the egg deposition site for the following 2 reasons: (1) The males defend the site against other males only. When males are attending egg clutches, they do not remove spoiled eggs or clean the clutch of predatory insects. The clutch is defended only in terms of other *T. petropolitana*. (2) We discovered only one site where *T. petropolitana* was in a natural habitat—a waterfall. In contrast to the road cut, the population density of *T. petropolitana* here was very low. Our impression was that there were few protected but open rock surfaces with a film of water flowing over that were suitable for *T. petropolitana* egg deposition sites. The males of *Thoropa miliaris*

do not attend egg clutches, and we saw no instances of territorial behavior in *T. miliaris*. Eggs of *T. miliaris* occur in much more exposed and horizontal situations than those of *T. petropolitana*, suggesting that the egg deposition sites of *T. miliaris* are not as limited a resource as for *T. petropolitana*.

In his recent review, Wells (1977) listed 2 species each of *Leptodactylus* and *Eleutherodactylus* as the only Neotropical leptodactylids for which territorial behavior had been reported. The occurrence of territoriality in the distantly related *Thoropa petropolitana* suggests that territoriality in leptodactylid frogs may be much more common than previously thought.

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